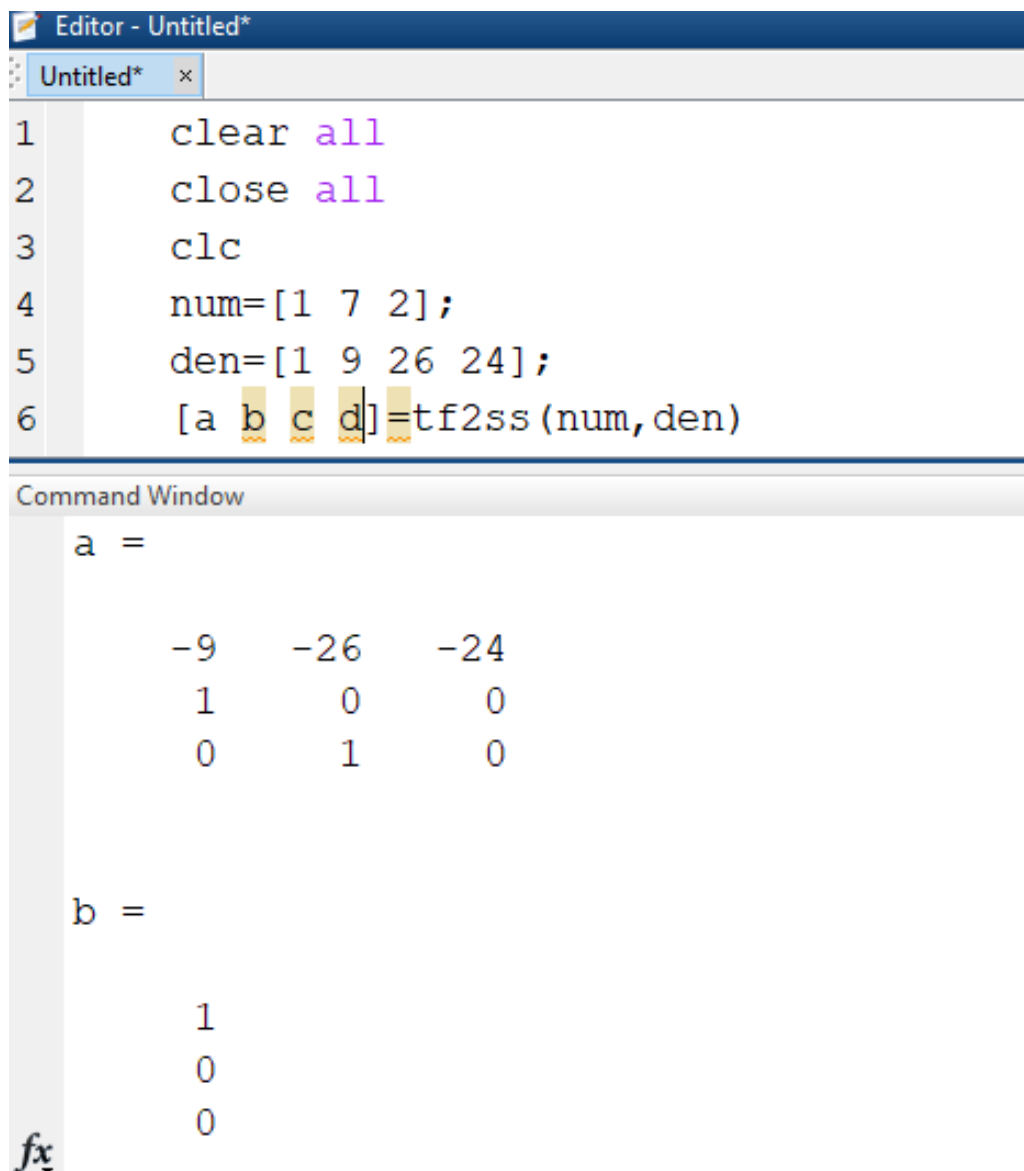


## STATE SPACE & BLOCK DIAGRAM

State space The classical control theory and methods are based on a simple input-output relationship of the plant, usually expressed as a transfer function. These methods do not use any knowledge of the interior structure of the plant, and limit us to single-input single-output (SISO) systems, and as we have seen allows only limited control of the closed-loop behavior when feedback control is used.

**tf2ss:** Convert transfer function filter parameters to state-space form



```
Editor - Untitled*
Untitled* x
1 clear all
2 close all
3 clc
4 num=[1 7 2];
5 den=[1 9 26 24];
6 [a b c d]=tf2ss(num,den)

Command Window
a =
    -9    -26    -24
     1     0     0
     0     1     0

b =
     1
     0
     0
fx
```

**ss2tf**: Convert state-space filter parameters to transfer function form

```
Editor - Untitled*
Untitled* x
1 clear all
2 close all
3 clc
4 a=[0 1 0 ; 0 0 1 ; -1 -2 -3];
5 b=[10 ; 0 ; 0];
6 c=[1 0 0];
7 d=0;
8 [num,den]=ss2tf(a,b,c,d);
9 sys=tf(num,den)
10

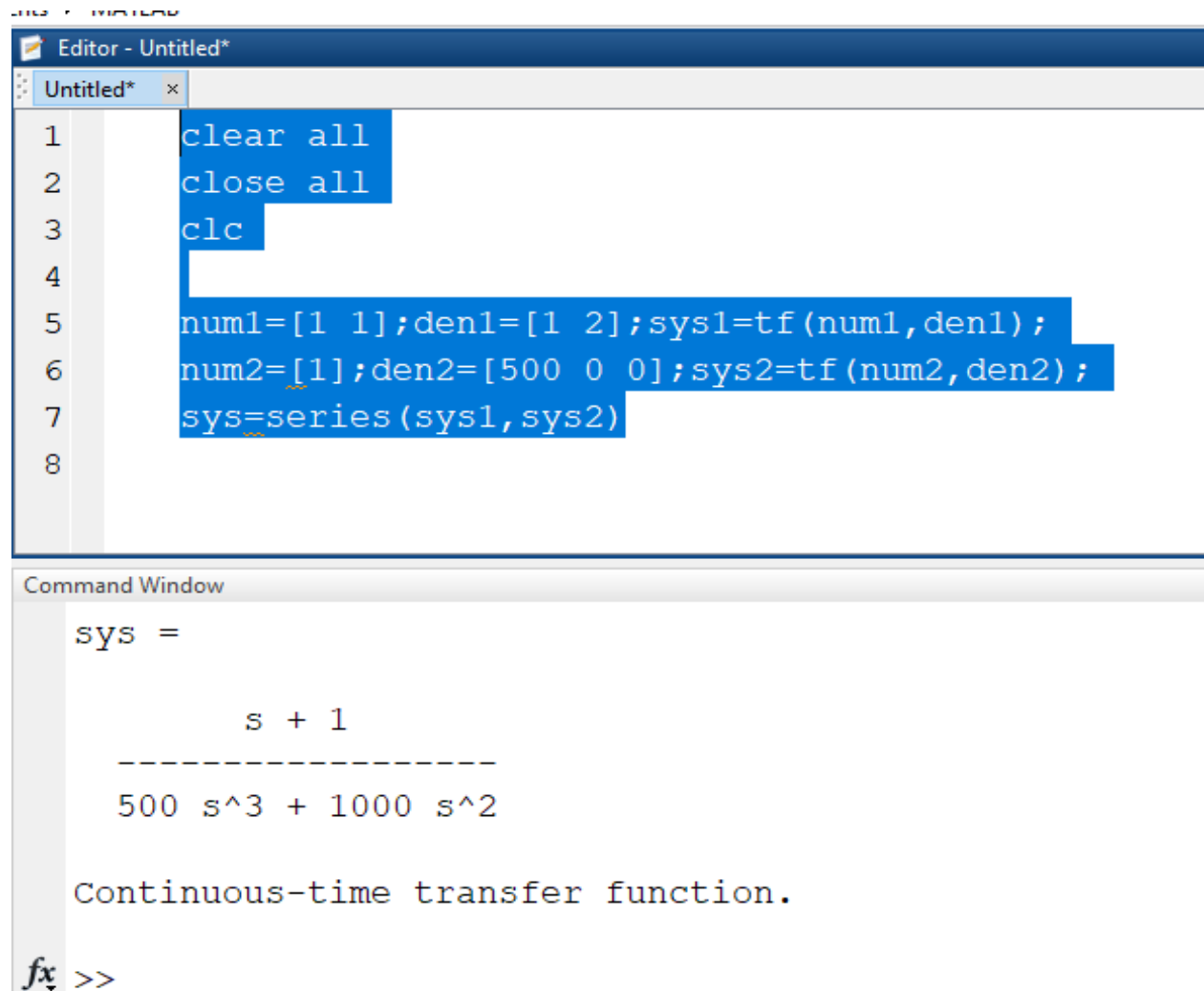
Command Window
sys =

    10 s^2 + 30 s + 20
    -----
    s^3 + 3 s^2 + 2 s + 1

Continuous-time transfer function.
fx \>
```

## Block Digram Reduction

Series Configuration: If the blocks are connected as shown below then the blocks are said to be in series. It would like multiplying two transfer function. The MATLAB command for the such configuration is "series"



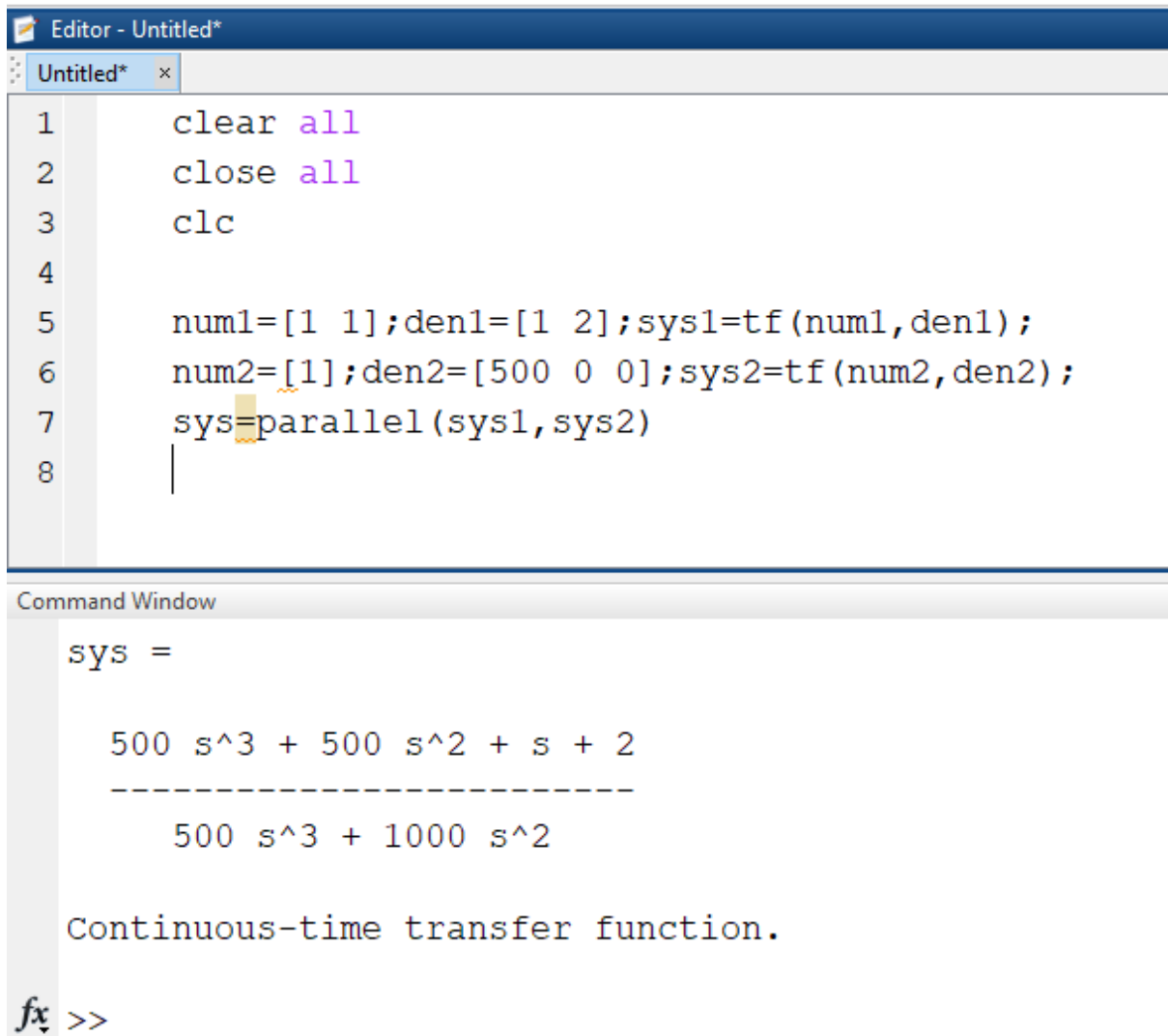
The image shows a MATLAB environment with an Editor window and a Command Window. The Editor window contains the following MATLAB code:

```
1 clear all
2 close all
3 clc
4
5 num1=[1 1];den1=[1 2];sys1=tf(num1,den1);
6 num2=[1];den2=[500 0 0];sys2=tf(num2,den2);
7 sys=series(sys1,sys2)
8
```

The Command Window displays the result of the MATLAB command:

```
sys =
      s + 1
-----
500 s^3 + 1000 s^2
Continuous-time transfer function.
fx >>
```

Parallel configuration: If the blocks are connected as shown below then the blocks are said to be in parallel .It would like adding two transfer functions.



```
Editor - Untitled*
Untitled* x
1 clear all
2 close all
3 clc
4
5 num1=[1 1];den1=[1 2];sys1=tf(num1,den1);
6 num2=[1];den2=[500 0 0];sys2=tf(num2,den2);
7 sys=parallel(sys1,sys2)
8 |

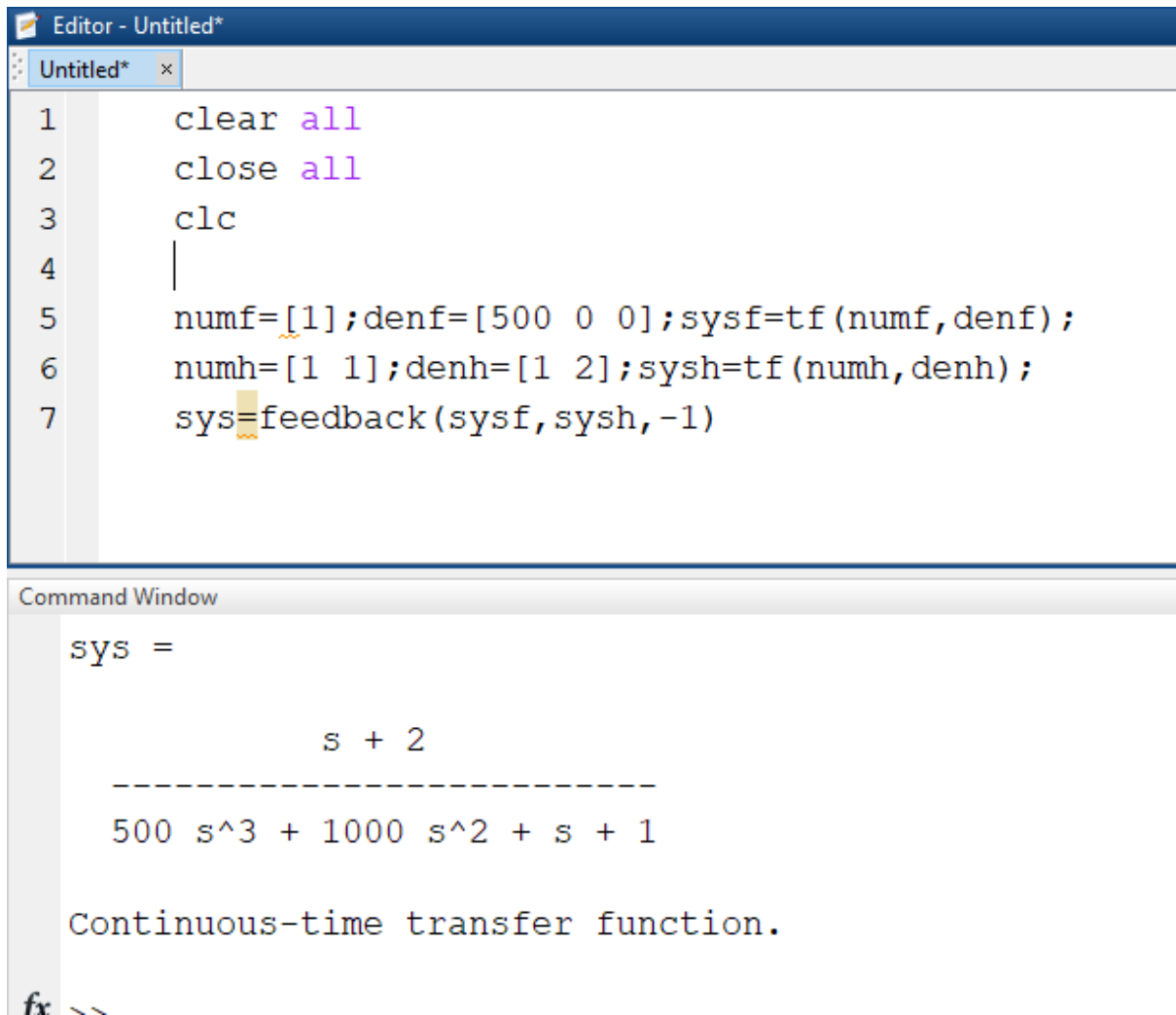
Command Window
sys =

    500 s^3 + 500 s^2 + s + 2
-----
    500 s^3 + 1000 s^2

Continuous-time transfer function.

fx >>
```

Feedback configuration: If the blocks are connected as shown below then the blocks are said to be in feedback. Notice that in the feedback there is no transfer function  $H(s)$  defined. When not specified,  $H(s)$  is unity. Such a system is said to be a unity feedback system.



```
Editor - Untitled*
Untitled* x
1 clear all
2 close all
3 clc
4 |
5 numf=[1];denf=[500 0 0];sysf=tf(numf,denf);
6 numh=[1 1];denh=[1 2];sysh=tf(numh,denh);
7 sys=feedback(sysf,sysh,-1)

Command Window
sys =

          s + 2
-----
500 s^3 + 1000 s^2 + s + 1

Continuous-time transfer function.
fx >>
```